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NOTES ON THE AMERICAN DISTRIBUTION OF SOME SPECIES OF COLEOPTERA COMMON TO THE EUROPEAN AND NORTH AMERICAN CONTINENTS.

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It has long been known to collectors of Coleoptera that European species unknown to other parts of North America may be taken in the Maritime Provinces of eastern Canada. Some of these species are abundant, and virtually all who have collected in the region have had some experience with them. The region of the Lower St. Lawrence and adjacent parts of the Province of Quebec have also supplied the first North American records of a number of European species. Because these species are of some special interest, I have compiled the list given below. The list is arbitrarily limited. It is restricted to European species occurring in eastern Canada which were first known in North America from the Maritime Provinces, southern Quebec, or adjacent regions, or which were reported from these regions a few years after being discovered in the United States. European species known to have invaded Canada from the south have been omitted, as have all pests of stored products and all species undoubtedly native to both the North American and European continents. Several species of *Sitona*, *Brachyrhinus*, and *Aphodius*, and a number of other species have been omitted because early records of their capture are unobtainable or indefinite. However, I have included several species the early histories of which are very poorly known.

The list includes forty-seven species. The early American history of one of them, *Sphaeridium lunatum* Fab., is entirely unknown, and one was first found in Newfoundland. Twenty of the species were first collected in the Maritime Provinces. About half the remainder were first taken in the Lower St. Lawrence region or in adjacent parts of Quebec, and about half were first found in the northeastern portion of the United States. Nine species not previously recorded as occurring in North America are included in the list; they are *Trechus rubens* Fab., *Pseudophonus rufipes* DeG., *Sphaeridium lunatum* Fab., *Agriotes obscurus* L., *Agriotes sputator* L., *Tropiphorus tomentosus* Msh., *Tropiphorus obtusus* Bonnd. (?), *Philopodon plagiatus* Schall., and *Brachyrhinus porcatus* Hbst. Five others have been reported in North America but are not included in the Leng catalogue or in any of its supplements; they are *Bradytus fulvus* DeG., *Aphodius scrofa* Fab., *Geotrupes stercorarius* L., *Brachysomus echinatus* Bonnd., and *Brachyrhinus ligneus* Oliv.

It is interesting to note the habits and relationships of the species of the list. The family best represented is the Curculionidae with eighteen species. Twelve of these belong to the Otiorhynchinae, a group of species which develop in the soil and which are sometimes parthenogenetic. The other Curculionids listed are species that develop in the soil or on low-growing plants. The Carabidae and Scarabaeidae are each represented by nine species, and all of the latter family are dung-feeders. There are four species of Hydrophilidae, and three of them are dung-feeders. The Staphylinidae, Elateridae, and Chrysomelidae are each represented by two species, and all of them live on or in the soil

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with the exception of one Chrysomelid that feeds on burdock. A single Coccinellid completes the list. It is noteworthy that the species belong to a small number of families, that many of them are dung-feeders, and that, with the exception of a few associated with low-growing plants, all are closely associated with the soil. The Maritime Provinces have received little attention from collectors, and past experience suggests that there remain to be discovered there numerous European species of such groups as the Staphylinidae, Carabidae, and Sphaeridiinae.

It may be noted that every species listed is widely distributed in northern or middle Europe or in both regions. Most of them are common over large parts of the European continent. Two of the species, *Coccinella undecimpunctata* L. and *Philopodon plagiatus* Schall., are restricted largely to coastal regions in Europe and may be expected to restrict themselves similarly in North America. *Aphodius fimetarius* L. and the three species of *Sphaeridium* are widely distributed in southern Canada and in the United States. The American distribution of the others falls into several patterns. Ten species have been taken only in the Maritime Provinces, while two others have been found only there and in coastal localities of Quebec. Five have been found only in the Maritime Provinces and in neighboring parts of the United States, and four have been taken only in these regions and in Quebec. Four species are known only from single localities on the St. Lawrence River. Fourteen of the species extend into eastern Ontario, and while none of these have been taken west of Georgian Bay in Ontario or in the three Prairie Provinces, six of them occur also in British Columbia. These are *Carabus nemoralis* Müll., *Carabus granulatus* L., *Strophosoma melanogrammum* Forst., *Brachyrhinus singularis* L., *Hypera punctata* Fab., and *Hypera nigrirostris* Fab. Moreover, while twelve of these fourteen species occur in the United States, only four of them have been recorded in that country from regions west of Lake Huron. These are *Aphodius fessor* L. which has been reported from Michigan and Iowa, *Hypera punctata* Fab. and *H. nigrirostris* Fab. which now occur in the Middle West and Pacific regions, and *Carabus nemoralis* Müll. which is restricted to the northeastern states and to states bordering the Pacific coast. The species that occur in the United States tend to restrict themselves to northern as well as to eastern regions. Only four of them are recorded from North Carolina. Finally, two of the listed Curculionids extend into Manitoba and occur also in northeastern United States.

In deciding whether a species such as any listed is introduced or native to America, one can be guided only by its known history and by its distributional pattern, although in other cases other facts such as the prevalence of parasites may be suggestive. A very misleading picture of the past distribution of a species may result from collectors' records. Nevertheless, the histories of the genus *Sphaeridium* and of such species as *Carabus nemoralis* Müll., *Sitona cylindricollis* Fahr., and *Aphodius prodromus* Brahm. are sufficient evidence that they were introduced into North America. The great majority of truly holarctic species have a transcontinental distribution in northern United States or in Canada. A few species of Coleoptera, such as the Elaterid *Ludius sjaelandicus* Müll. which appear to be native to both North America and Europe are restricted in America to northeastern United States and adjacent parts of Canada, but the number of authenticated cases of such distribution is very small. There is no reason to believe that any Nearctic species in the Coleoptera is restricted to the region about the Gulf of the St. Lawrence and to the Maritime Provinces. With these facts in mind, and considering their wide Palearctic distribution, I believe one must conclude that species as restricted in America as *Carabus granulatus* L., *Helophorus aquaticus* L., *Geotrupes stercorarius* L., and numerous others of the list were introduced into this continent. *Helophorus aquaticus* L. was first reported in America by Darlington who had specimens from New

Brunswick, Maine, and New Hampshire (1927, Psyche, XXXIV, 174). Darlington wrote that "the species is well distributed and probably native, but apparently rare". In 1927, my first year in Canada, and during subsequent years, the species occurred very abundantly about Ottawa. It is frequently taken here by general collectors who have no special interest in Coleoptera, but it is not contained in the collections nor is it mentioned in the writings of Harrington or other early collectors of the Ottawa district. These facts, together with its Palearctic distribution, suggest that the species appeared recently at Ottawa and is therefore not native to America. I believe that all the species of the following list are introduced and that their present American distributions, or their known histories or both, justify this belief.

Some of these ideas are not in accord with those held fifty years ago by Schwarz (1890, Insect Life, III, 38). In writing of species of *Brachyrhinus* (= *Otiorhynchus*), he referred to *B. ovatus* L. as a circumpolar species and wrote of *B. sulcatus* Fab., "As to the future course of this pest we do not anticipate.....that it will spread very much. The species was already known from North America to coleopterists more than sixty years ago and is confined to the extreme northeastern portion of the country (from New York northward to Newfoundland and Nova Scotia). For this reason we are inclined to believe that it is not an imported species but that it belongs (with the other species of *Otiorhynchus* known from North America) to the circumpolar fauna." Both *sulcatus* and *ovatus*, which were known only from eastern regions in 1890, are now widely distributed in North America. If they have spread since 1890 as collecting records indicate, they are evidently introduced species. There are no apparent reasons why their spread should be associated with the settlement of the country as was that of *Leptinotarsa decemlineata* Say. Most authors have considered them introduced. However, Downes (1931, Can. Dept. Agr. Pamp. 5, n. s., ed. 2, 3), writing on the occurrence of *ovatus* in British Columbia, states, "There seems to be no doubt that the beetle is a native one. It is present in all the settled portions of the southern part of the province and has been found on rock islands away from settlements where it could not possibly have been introduced artificially, and at various altitudes up to 4,000 feet in the mountains." Wilcox, Mote, and Childs (1934, Ore. Agr. Exp. Sta. Bull. 330, 6, 16) state that some species of *Brachyrhinus* are apparently indigenous to America. They note the occurrence of fossil species of the genus in Colorado and, in support of their idea, they give the above quotation from Downes and quote Horn as follows, "their distribution being due to natural laws and not through the agency of commerce." Both *ovatus* and *sulcatus* have shown themselves to be very adaptable species. It should be quite possible for some adaptable species, if introduced, to spread by "natural" means and thus acquire distributions similar to those of truly holarctic species. Reference to Horn (1876, Proc. Am. Philos. Soc., XV, 60) shows that the above quotation refers only to the occurrence of two European species in Greenland. Horn adds, "This genus contains in our fauna species which have been introduced from Europe, and which have established themselves in the north-eastern parts of our territory." I know of no reasons for considering any species of *Brachyrhinus* native to North America.

Mentioned above are six of the listed species that are or were apparently restricted in North America to eastern and far western regions and unknown from intermediate localities. Other species generally considered introduced have shown similar distributional patterns. Among these are the weevils *Barypeithes pellucidus* Boh. which occurs at Victoria, B. C., *Brachyrhinus sulcatus* Fab., *Brachyrhinus rugosostriatus* Goeze, and *Sitona hispidulus* Fab. Such erratic distribution shows that some species lend themselves readily to introduction and have established colonies on more than one occasion. It is possible that some

introduced species confined to the east have established themselves more than once, and collectors' records suggest that *Aphodius subterraneus* L. has done this. Such behaviour and the present distribution of some species show that the behaviour of one species may be a most unsatisfactory index to the behaviour of allied forms. In the genus *Aphodius*, three species evidently introduced, *fimetarius* L., *granarius* L., and *distinctus* Müll., have spread throughout the major portion of the United States and southern Canada. Four species listed below, *fossor* L., *erraticus* L., *haemorrhoidalis* L., and *prodromus* Brähm have become abundant and widely distributed but have restricted themselves to northeastern United States and to adjacent parts of Canada. Two others of the list, *scrofa* Fab. and *subterraneus* L., have been in America long enough to spread over considerable areas and to build up large populations but have restricted themselves to regions near the eastern coast. All of these species have similar habits, and all are widely distributed in the Palearctic region. And the genus contains numerous other species, having similar habits and widely distributed in Europe, which have never been found in North America.

It has been noted that the species listed below are more or less closely associated with the soil. The occurrence of such introduced species in maritime regions may perhaps be explained in part by the "ballast theory" developed by botanists to explain the introduction of many plants. In former days ships used ballast of sand or other soil. Thus they carried seeds from the shores near their starting places and usually discharged them on soil similar to that from which they came. Lists of plants collected from North America ballast heaps include chiefly European species. Some of these, such as beach inhabiting species, are true ballast plants, while others are more closely associated with the dung and fodder of cattle. These lists are often quite lengthy and include a great many species that fail to establish themselves. Writing in 1900 of St. Andrews, N. B. (1901, Proc. Nat. Hist. Assoc. of Miramichi, no. 11), Fowler states, "In the early half of the century St. Andrew's was one of the busiest centres of commercial activity in the province, and was especially distinguished for its export of lumber The seeds of weeds brought in vessels from foreign lands secured a foothold on the vacant grounds Probably no locality of equal area in Canada can boast of a larger percentage of foreign plants in its Flora than that which flourishes on the streets and in the neighborhood of St. Andrew's Of 32 species of Compositae collected, 20 were of foreign origin." The coasts of the Maritime Provinces are well supplied with old ballast heaps. That ballast has been held responsible for the introduction of Coleoptera is shown by a number of statements contained in the literature. Harrington noted the occurrence of *Barynotus* near ballast at Sidney, N. S. (1891, Can. Ent., XXIII, 22), and stated, "The Ballast heaps, I may add, are formed by vessels discharging their ballast of stone, earth, etc., before loading coal, and many species of introduced plants are found on, or about them." Commenting on the capture about 1889 of specimens of *Onthophagus nuchicornis* L. near Camden, N. J., Horn stated that the species was "doubtless introduced with ballast refuse" (1889, Trans. Am. Ent. Soc., XVI, p. X).

In preparing the following list, I have tried to include, except in the case of *Sphaeridium scarabaeoides* L., the first published record of the occurrence of each species in North America together with other records of interest. It is possible that I have overlooked a few important records. I have been assisted by several individuals whose help is acknowledged below. In addition Mr. L. L. Buchanan has supplied me with opinions on the nomenclature of several Curculionids and Mr. R. P. Gorham with literature on plants introduced into the Maritime Provinces.

LIST OF SPECIES

Carabus nemoralis Müll. This species was first recorded from North America by Horn who noted it common at St. John, N. B., in 1890 (1892, Ent. News, III, 60). Harrington took it at St. John the same year (1892, Can. Ent., XXIV, 112); Harrington's specimens of this species and of *Carabus granulatus* L. were taken September 6, 1890, not 1891 as Harrington states. The species was taken at Montreal, Que., in 1913 (1914, 44th Rept. Ent. Soc. Ont., 1913, 113) and was reported very common at Toronto, Ont., in 1922 (1923, 53rd Rept. Ent. Soc. Ont., 1922, 10). Park found it abundant at Chicago, Ill., in 1926 (1929, Jour. N. Y. Ent. Soc., XXXVII, 434). It has been taken at Halifax, N. S. (1924), at St. Stephens (1917), St. Andrews (1917), and Shediac (1926), N. B., and at Ottawa, Ont. (1928). According to the Smith list, the species was taken at several localities in New Jersey before 1910. It was found on Staten Island, N. Y., by Davis in 1915 (1928, Bull. Brook. Ent. Soc., XXIII, 198) and is collected at Framingham, Mass., by Mr. C. A. Frost. According to Essig, the species was first found in California at San Francisco in 1919 and was collected at Portland, Ore., in 1926 and at Seattle, Wash., in 1928 (1931, A History of Entomology, 285). Leech states that it was found at Victoria, B. C., in 1923 and was collected subsequently at mainland and interior localities in British Columbia (1935, Pan-Pac. Ent., XI, 120). These appear to be the only records of the occurrence of the species in localities west of Chicago.

Carabus granulatus L. The only published North American record of this species seems to be that of Harrington who took three specimens at St. John, N. B., in 1890 (1892, Can. Ent., XXIV, 112). In addition to the Harrington specimens, the Canadian National Collection contains specimens from St. Andrews (1917), St. Stephen (1917), and Shediac (1939), N. B., and from Yarmouth (1910), Kentville (1923), and Wolfville (1924), N. S. Mr. C. A. Frost informs me that he has taken the species at Natick, Mass. (since 1931), and at Penobscus, N. B. (1926), and that he has a specimen from Terrace, B. C. (1932).

Trechus rubens Fab. Recent authors have considered earlier writers in error in assigning American specimens to *rubens* and have used other names for American examples. However, Dr. P. J. Darlington, Jr., informs me that the true *rubens* is represented in the collections of the Museum of Comparative Zoology by specimens taken in Nova Scotia and that *rubens* differs from other species occurring in North America in possessing functional wings.

Lasiotrechus discus Fab. The only published North American records of this species are those of Chagnon, who took a specimen at Lanoraie, Que., in 1933 (1934, Can. Ent., LXVI, 168), and of Beaulne, who reported specimens taken at light at Granby, Que., in 1938 and 1939 (1940, Can. Ent., LXXII, 62). I took a specimen near Ottawa, Ont., in 1934, and subsequently a dozen specimens have been collected in the Ottawa district. All of these and the Lanoraie specimens were taken at light in or near sphagnum bogs.

Curtonotus aulicus Panz. Under the name *Amara aulica*, Fall recorded the capture of a single specimen of this species at Louisburg, N. S., in 1929 (1934, Pan-Pac. Ent., X, 171).

Bradytus fulvus DeG. The only published North American record of this species is based on specimens taken by myself at Natashkwan and Thunder River, Que., in 1929 and 1930 (1932, Can. Ent., LXIV, 200). These localities are situated on the North Shore of the Gulf of the St. Lawrence opposite Anticosti Island. In 1939 I found the species at Tabusintac, Tracadie, and Shediac, N. B. It occurred beneath cover on sand beaches and was very common.

Pristonychus terricola Hbst. Hamilton has stated that the Horn collection contains Nova Scotian specimens of this species (1894, Trans. Am. Ent. Soc., XXI, 354). The Canadian National Collection contains two specimens

taken by Mr. W. McIntosh at St. John, N. B., on July 16, 1900 and July 6, 1902.

Platynus ruficornis Goeze. Schwarz first recorded this species from North America in 1901 (Ent. News, XII, 62). His specimen came from northeastern Maine, and his record was published under the name *albipes* Fab. which is considered a synonym of *ruficornis* Goeze (not LeConte) by recent European authors. Dr. P. J. Darlington, Jr., informs me that *clemens* Lec. is also a synonym of *ruficornis*. The type of *clemens* was taken in Nova Scotia and came from the collection of Henry Ulke who is said to have collected in that province about 1859. The Canadian National Collection contains two specimens of *ruficornis* taken at St. John, N. B., on September 6, 1890, by Mr. W. H. Harrington.

Pseudophonus rufipes DeG.* I took two male specimens of this Carabid at Tabusintac, N. B., on June 19, 1939. Neither the genus nor the species has been recorded previously from North America. *Pseudophonus* Mots. is considered a subgenus of *Harpalus* Latr. by some authors. It falls with *Harpalus* in American keys but differs in having the elytra supplied with closely placed, fine, semi-erect, golden hairs as in *Chlaenius* Bon. *P. rufipes* is known as *pubescens* Müll. in much of the European literature, but the name *rufipes* DeG. has priority over both *pubescens* Müll. and *ruficornis* Fab. according to the most recent paper (1939, The Generic Names of British Insects, Part 6, 166). *P. rufipes* resembles the species of *Harpalus* of the *pennsylvanicus* group and agrees with them in having the dorsal face of each tarsus supplied with sparse, golden hairs. The species is a black insect, with red or reddish-yellow legs and antennae, and measures from 14 to 16 mm. The pronotum near its base is roughly sculptured and supplied with vestiture similar to that of the elytra except near the median line; elsewhere it is finely punctate, the punctures becoming sparser and somewhat indistinct on the middle portion. The posterior pronotal angles are right angles and are not at all rounded. The elytral intervals are alutaceous and finely and closely punctate; the punctures are closer, but otherwise this sculpture is similar to that of the female of *Harpalus vagans* Lec.

Helophorus aquaticus L. The only published North American records of this species are those of Darlington who noted its occurrence at Mt. Lafayette, N. H. (1927), Orono, Me., and Penobscot, N. B. (1927, Psyche, XXXIV, 174). The species is very abundant in the Ottawa district, but I have seen no specimens from more western regions. All Ottawa district specimens in the Canadian National Collection have been collected during the past fifteen years. Mr. G. Chagnon informs me that Montreal collectors have been taking *aquaticus* in the vicinity of that city for twenty years or more. I have collected it at Covey Hill, Que. (1927), and at Fredericton, N. B. (1928). In the "second" collection of Provancher is a specimen from Chicoutimi, Que., that Provancher must have acquired sometime between 1877 and 1892, the year of his death. *H. aquaticus* is most common in the spring and fall and favors temporary pools and the muddy or weedy margins of ponds and lakes.

Sphaeridium scarabaeoides L. The first North American reference to this species as a well established insect appears to be that of Chagnon who wrote in 1893 that it was very common at Montreal, Que. Between 1901 and 1904, the species was recorded from several localities in New York, New Jersey, Pennsylvania, and Delaware. Crew first found it at Toronto, Ont., about 1899 (1903, f 83d Ann. Rept. Ent. Soc. Ont., 1902, 96), and Knab has mentioned specimens taken at Chicago, Ill., in 1904. Most of these and other early records have been brought together by Barber (1905, Proc. Ent. Soc. Wash., VII, 127). Fletcher recorded *scarabaeoides* from St. John, N. B., in 1903 (1904, 34th Ann. Rept. Ent. Soc. Ont., 1903, 96), and Carr took it as early as 1920 at Edmonton, Alta. (1936, Can. Ent., LXVIII, 261). Blackwelder has stated that it was first recorded from northwestern America about 1913 and from California in 1920 (1931,

*I have recently received two specimens of this species collected by Mr. F. M. Cannon in 1937 at Summerside and Charlottetown, P. E. I.

Pan-Pac. Ent., VIII, 22). I found the species abundant in northeastern Kansas in 1922 and have specimens taken at Aweme, Man., in 1915 and at Vernon, B. C., in 1924. The species is very abundant and rather generally distributed throughout southern Canada, and much of the United States.

Sphaeridium bipustulatum Fab. This species was first reported in North America by Schaeffer who recorded it from Long Island, N. Y., in 1911 (Can. Ent., XLIII, 254). Leech noted its occurrence in 1931 at Vancouver and Salmon Arm, B. C. (1935, Pan-Pac. Ent., XI, 123). I took it at Lawrence, Kans., and Ottawa, Ont., in 1929, in the Lake Erie region of Ontario in 1931, and in northeastern New Brunswick in 1939.

Sphaeridium lunatum Fab. In 1914 Joy discovered a third species of *Sphaeridium*, separable by characters of the male genitalia, in his English material (1914, Ent. Mo. Mag. (2), XXV, 83). In 1919 Deville found the same species in France, determined that it should be known as *lunatum* Fab., and pointed out color characters by which the species may be recognized (1919, Bull. Soc. Ent. Fr., 230). *S. lunatum* is confused with *scarabaeoides* in Canadian collections. It is represented in the Canadian National Collection and in the collection of the Quebec Department of Agriculture by specimens from Annapolis Royal, N. S. (1928), Tabusintac, N. B. (1939), Quebec (1938), Oka (1937), and Knowlton (1927), Que., Ottawa (1928) and Point Pelee (1931), Ont., and from Agassiz (1926), Summerland (1936), and Kamloops (1937), B. C. The species is not represented among the small number of specimens I have seen from the United States. It is, of course, possible that the records of *scarabaeoides* noted above are based in part on *lunatum*, but all of the earlier specimens I have seen, including one taken at Toronto in 1899 and one taken at Montreal about the same time, are referable to *scarabaeoides*.

The following key to the species of *Sphaeridium* is based on that of Deville. The color characters are variable as noted in the key, but they may be relied upon if used with care.

1. Length 3.7 to 5.5 mm. Pronotum with its base more strongly bisinuate, the hind angles not obtuse. Apical portion of the mesosternal intercoxal process finely margined on each side and with a fine median carina. Claw joint of the male anterior tarsus with its anterior face subtruncate at apex. Pronotal sides with or without pale margins. Apical pale area of each elytron prolonged anteriorly along the lateral margin at least to the middle of the elytron. Discal red spot of each elytron usually indistinct or entirely lacking. Legs colored as in *scarabaeoides* *bipustulatum* Fab.
 - Length 5.5 to 7 mm. Pronotum with its base feebly bisinuate, the hind angles slightly obtuse. Apical portion of the mesosternal intercoxal process neither margined nor carinate. Claw joint of male anterior tarsus with its anterior face strongly angulate at apex and prolonged over the basal portion of the large claw 2
 2. Apical pale area of each elytron not or scarcely prolonged anteriorly along the lateral margin of the elytron. Discal red spot of each elytron very obscure and indistinct or entirely lacking, rarely well defined. Pronotal sides without pale margins. Legs darker, the femora brown or blackish, sometimes paler at base. Median lobe of aedeagus parallel, its apex obtusely rounded and produced at middle into a small angle *lunatum* Fab.
- Apical pale area of each elytron prolonged anteriorly along the lateral margin at least to the middle of the elytron. Discal red spot of each elytron well defined, rarely obscure and indistinct. Pronotal sides usually with the lateral margins pale. Legs paler, each femur usually

yellow with a median area and the anterior margin dark, sometimes dark except at base, rarely entirely dark as in *lunatum*. Median lobe of aedeagus gradually narrowed in apical half, its apex acute
..... scarabaeoides L.

Deleaster dichrous Grav. Chagnon has recorded the capture in 1934 of two specimens of this species at Longueuil (near Montreal), Que. (1934, Can. Ent., LXVI, 282).

Staphylinus globulifer Fourc. Chagnon has reported collecting in 1935 three specimens of this species within the city of Montreal, Que. (1936, Can. Ent., LXVIII, 116).

Agriotes obscurus L. This species, which has not been recorded from North America, is represented in the Canadian National Collection by five specimens labeled Kentville, N. S., June 24, 27, and 28, 1923, R. P. Gorham. I have seen specimens bearing similar labels in the collection of Dr. H. C. Fall. However, Mr. Gorham informs me that the specimens were collected at Dartmouth, N. S. In the Ulke collection at the Carnegie Museum, I have seen specimens of *obscurus* labeled "N. S." Ulke is said to have collected in Nova Scotia about 1859. In these collections, *obscurus* is confused with *manicus* Say to which it is very closely allied. In *manicus* the prosternum is flat between the coxae. In *obscurus* the prosternum is rather strongly concave between the coxae, and the body is usually slightly larger and more robust.

Agriotes sputator L. I found a single specimen of this species in beach drift at Tabusintac, N. B., on June 20, 1939. The species has not been noted previously from North America. It measures from 6.5 to 8.5 mm. It is black, with the anterior margin and posterior angles of the prothorax and the elytra reddish-brown or reddish-yellow, and with the legs and antennae reddish-yellow. In LeConte's key (1884, Trans. Am. Ent. Soc., XII, 15), it falls near *avulsus* Lec., but it differs in color and sculpture from all the species of that section of the key.

Coccinella undecimpunctata L. Dobzhansky has recorded this species from Stoneham, Nahant, and Falmouth Heights, Mass., and from the Rampart House district of Alaska (1931, Proc. U. S. N. M., LXXX, art 4, 28). It is represented in the Canadian National Collection by a specimen taken a good many years ago at Rimouski, Que., by a specimen taken in 1939 at Brackley Beach, P. E. I., and by several taken at Tracadie and Tabusintac, N. B., in 1939. Most of the Tracadie specimens were collected as pupae from coarse grass growing on sand beaches. According to Dobzhansky, "This species lives only along the sea coasts of Europe; on saline soils of Middle and Central Asia, and along the coast of the Polar Ocean from Greenland to the mouth of Yenisei." The scarcity of collectors' records shows that the species is not generally distributed on North American coasts.

Onthophagus nuchicornis L. Under the name *rhinoceros* Melsh., Melshheimer reported this species from Pennsylvania in 1844 (Proc. Ac. Nat. Sci. Phila., II, 134). Contemporaneous records are lacking. In 1881 Henshaw found the species on the Magdalen Islands (1887, Can. Ent., XIX, 160), and Bland reported in 1889 its occurrence near Camden, N. J. (Trans. Am. Ent. Soc., XVI, p. X). Evans found it common at Halifax, N. S., in 1897 (1899, Can. Ent. XXXI 321) and in 1899 Roy recorded it from Ulric, Matane Co., Que. (Nat. Can., XXVI, 177). Fletcher found it abundant at St. John, N. B. in 1903 (1904, 34th Ann. Rept. Ent. Soc. Ont., 1903, 96). The species is recorded from New York and New Jersey and is very abundant and generally distributed in Nova Scotia, New Brunswick, and southern Quebec. I have seen no specimens from regions west of the Ottawa district.

Aphodius fossor L. The earliest North American record of this insect appears to be that of D'Urban who collected specimens in 1858 at Rivière du Loup and Ste. Anne, Que. (1859, Can. Nat. and Geol., IV, 244). Jones reported the species common at Halifax, N. S., in 1869 (Trans. N. S. Inst. Nat. Sci., II, 147). Provancher reported it from Portneuf, Que., in 1870 (Nat. Can., II, 178), and Hubbard and Schwarz listed it from Michigan in 1878 (Proc. Am. Philos. Soc., XVII, 655). It has been recorded from New York, New Jersey, Pennsylvania, North Carolina, and Iowa and occurs abundantly in southern Canada from Nova Scotia to the Georgian Bay region of Ontario.

Aphodius subterraneus L. A colony of this species was found at Ruthersford, N. J., in 1925 by Schott (1926, Bull. Brook. Ent. Soc., XXI, 17). Specimens taken at Portauisque, N. S., in 1929 by Mr. C. A. Frost have been recorded (1929, 60th Ann. Rept. Ent. Soc. Ont., 153), and Proctor has reported the species on Mount Desert Island, Me. (1938, Biological Survey of the Mount Desert Region, Part VI, 143). Mr. J. N. Knull collected a specimen at Bathurst, N. B., in 1922, and I found it at Annapolis Royal, N. S., and at several localities in central and southeastern New Brunswick in 1928. Subsequent collecting has shown that the species is very abundant throughout eastern New Brunswick and that it occurs commonly at Halifax, Yarmouth, and Petite Rivière, N. S. In Quebec it is known only from the region north of New Brunswick and south of the St. Lawrence River. In 1934 a specimen was taken near the Cascapédia River in the central part of the Gaspé Peninsula, and the Rev. Brother Joseph Ouellet collected specimens at Sully, Temiscouata Co., in 1936 and near Percé in 1939.

Aphodius erraticus L. Melsheimer, under the name *pensvallensis* Melsh., recorded this species from Pennsylvania in 1844 (Proc. Ac. Nat. Sci. Phila., II, 135). There are no contemporaneous records. Lugger found a thriving colony of *erraticus* at Baltimore, Md., in 1878 (1886, Ent. Amer., II, 84), and Evans collected it at Halifax, N. S., in 1897 (1899, Can. Ent., XXXI, 321). The species was recorded from Montreal, Que., in 1904 (Can. Ent., XXXVI, 164) and from the Ottawa district in 1914 (1915, 45th Rept. Ent. Soc. Ont., 1914, 137). The species is recorded from New York. It is very abundant in southern Canada but is not known to occur west of eastern Ontario.

In 1869 Jones reported *Aphodius scybalarius* Fab. as not uncommon about Halifax, N. S. (Trans. N. S. Inst. Nat. Sci., II, 147). As subsequent records of this species are lacking, it seems probable that Jones's specimens should have been referred to *erraticus*.

Aphodius haemorrhoidalis L. The first North American record of this species is that of Schaeffer who recorded it from Secaucus and Hackensack meadows, N. J., in 1915 (Jour. N. Y. Ent. Soc., XXIII, 50). During the past fifteen years, the species has been taken in numbers at several localities in Nova Scotia, New Brunswick, southern Quebec, and in the Ottawa district. It is recorded from New York and North Carolina.

Aphodius fimetarius L. In 1838 Randall recorded this species under the name *nodifrons* Rand. and wrote that it was "extremely abundant throughout all Maine." D'Urban wrote in 1859 that the species was very abundant near Montreal, Que., and abundant from Metis, Que., to the Metapedia River (Can. Nat. and Geol., IV, 244, 315). A year later he recorded it from the Rouge River which is some miles west of Montreal (1860, Can. Nat. and Geol., V, 83). Couper collected the species on Anticosti Island in 1873 (1874, Can. Ent., VI, 137). Bethune, writing at Port Hope, Ont., in 1872, reported it common in Canada (1873, Rept. Ent. Soc. Ont., 1872, 72). The species was reported from Michigan in 1878 (Proc. Am. Philos. Soc., XVII, 655). At present it is common and generally distributed in southern Canada from Nova Scotia to British Columbia and occurs commonly over the major portion of the United States.

Aphodius scrofa Fab. The only published North American records of this species are those of Frost who has noted specimens taken at Aldouane, N. B., in 1928 and at Weld, Me., in 1938 (1939, Ent. News, L, 30). In 1928 I found the species at Sackville, Bouctouche, Aldouane, and Boiestown, N. B., and in 1939 at Tabusintac, N. B. I have seen a specimen taken at Roberval, Lake St. John district, Que., in 1938 by Mr. S. Dumont, and the Rev. Brother Joseph Ouellet collected *scrofa* at Lauzon, Que., in 1939. The species measures from 3 to 3.5 mm. and is black, opaque, and pubescent above. It falls with *stupidus* Horn in keys to the American species of *Aphodius* but differs in being more strongly opaque, more distinctly pubescent, and in lacking an impressed marginal line on the pronotal base.

Aphodius prodromus Brahm. Under the name *consputus* Creutz, Fernald reported this species very common at Orono, Me., in 1878 (Bull. Brook. Ent. Soc., I, 23). Horn noted a specimen from Montreal, Que., in 1887 (Trans. Am. Ent. Soc., XIV, 60). In 1898 Harrington wrote that the species had been noted at Ottawa, Ont., for four or five years and that it had become very abundant (1899, 29th Ann. Rept. Ent. Soc. Ont., 1898, 87). At present the species is known to occur abundantly from New Brunswick to eastern Ontario. It is recorded from New York, and I have seen specimens from Massachusetts.

Geotrupes stercorarius L. Gorham collected this species at Fredericton and Scotch Lake, N. B., in 1928 (1929, 59th Ann. Rept. Ent. Soc. Ont., 1928, 15). It is represented in the Canadian National Collection by numerous specimens from these localities and from Tabusintac, Bathurst, and Shediac, N. B., and from Alma and Bedford, P. E. I. The Alma specimens were taken in 1915, one of the Fredericton specimens in 1918, and the others during subsequent years. The species is very abundant throughout eastern New Brunswick where it appears to restrict its feeding to horse manure. In *stercorarius* the elytra are usually feebly bronzed or bluish, and the size is larger than in native species of the genus, the specimens measuring from 17 to 25 mm. The species has the second segment of each antennal club strongly emarginate and belongs in *Geotrupes* s. str. which differs from the subgenus *Anoplotrupes* Jek. in having three, rather than two, entire carinae on the outer side of each hind tibia and in having, in the male, the posterior margin of the hind femur dentate near its base and the posterior face of the front tibia toothed and lobed.

Chrysolina staphylea L. This species is known in America only from Halifax, N. S., where its occurrence has been noted by two authors. In 1897 Evans took a single specimen there that he identified doubtfully as *staphylea* (1899, Can. Ent., XXI, 321). Evans' specimen is before me and proves to be that species. Knab reported the capture of three specimens on McNabs Island, Halifax, in 1910 (1911, Ent. News, XXII, 306).

Cassida rubiginosa Müll. The only published records of the occurrence of this species in North America appear to be those of Fyles and Roy who found it breeding on burdock at Levis, Que., in 1902 (1902, Can. Ent., XXXIV, 273; 1902, Nat. Can., XXIX, 145). The species has been found abundantly on the same host during recent years at Montreal, Knowlton, and Brome, Que., and at Shediac, N. B. I have taken it on several occasions in the Ottawa district where it seems to be scarce. While Fyles recorded the species as *viridis* L. and Roy as *thoracica* Ill., it has been identified as *rubiginosa* Müll. by more recent authors. The species recorded from Illinois by Crotch as *thoracica* Ill. (1873, Proc. Ac. Nat. Sci. Phila., XXV, 78) is evidently that described recently as *relictus* by Spaeth.

Tropiphorus tomentosus Msh. and *Tropiphorus obtusus* Bonsd. (?). These two species of *Tropiphorus*, a genus new to North America, have been

found in eastern Canada and identified by Mr. L. L. Buchanan. Several specimens of *tomentosus* were taken at Truro, N. S., in 1913, a single specimen was taken in 1917 by Dr. Georges Maheux at Quebec, Que., and Mr. R. P. Gorham collected two specimens at Charlottetown, P. E. I., in 1936. Collecting in sod at Yarmouth, N. S., in 1933, Mr. F. C. Gilliatt found two specimens that were identified tentatively by Mr. Buchanan as *obtusus*. *Tropiphorus* Schön. is allied to *Panscopus* Schön. and *Dyslobus* Lec. and falls near these genera in Pierce's key (1913, Proc. U. S. N. M., XLV, 378). It differs from these and other allied genera in having the tarsal claws connate at base. The median line of the pronotum is finely cariniform except in some specimens of *tomentosus*. The postocular lobes are scarcely evident, but the prothoracic margin is supplied with vibrissae behind the eyes which are scarcely convex. The two species are quite robust, are covered with elongate scales, and measure from 5 to 5.6 mm. They may be separated as follows:

Humeral angles of the elytra prominent, the elytra at base distinctly wider than the base of the pronotum. Elytral intervals lacking semi-erect setae *tomentosus* Mshn.

Humeral angles of the elytra not prominent, the elytra and pronotum of equal width at their bases. Each elytral interval with a row of semi-erect setae *obtusus* Bonsd. (?)

Sciaphilus asperatus Bonsd. This species has been known as *muricatus* Fab. in the American literature. The earliest North American record appears to be that of Harrington who collected it at Sydney, N.S., in 1884 and 1890 (1891, Can. Ent., XXIII, 23, 114). Henshaw reported it at Brookline, Mass., in 1888 (Psyche, V, 137). It was recorded subsequently from Newfoundland and from several localities between Quebec and New Jersey. The Canadian National Collection contains specimens from Annapolis Royal and Kings Co., N. S., Fredericton, N. B., Knowlton, Que., and from Ottawa, Chatham, and Orillia, Ont.

Strophosoma melanogrammum Forst. This species has been known as *coryli* Fab. in the American literature. The first North American record is that of Julich who noted the occurrence of the species in the Orange Mountains of New Jersey in 1885 (Ent. Amer., V, 56). Henshaw recorded it from Brookline, Mass., in 1888 (Psyche, V, 137). Ouellet recorded it from Montreal, Que., in 1902 (Nat. Can., XXIX, 140), and it was reported subsequently from New York and several localities in New England. The Canadian National Collection contains specimens from Truro, Lingan, and Baddeck, N. S., and from Victoria and Agassiz, B. C.

Barynotus obscurus Fab. LeConte recorded *Barynotus schönherri* Zett. from southern Newfoundland in 1876 (Proc. Am. Philos. Soc., XV, 22). Recent European authors consider *schönherri* a variety of *squamosus* Germ. As all Canadian specimens of the genus are referable to *obscurus*, I presume that LeConte's specimen also represents this species. The earliest Canadian record is that of Harrington who collected specimens at Sydney, N. S., in 1884 (1891, Can. Ent., XXIII, 21). The species has been recorded from Lawrencetown, N. S., and St. John, N. B., and is represented in the Canadian National Collection by specimens from Wolfville, Halifax, Cape George, St. Peters, and Kings Co., N. S., and from Fredericton, St. Andrews, and Tabusintac, N. B. I have seen two specimens collected near Quebec, Que. Blatchley and Leng recorded the species from Maine and Massachusetts, but Blatchley has written that these records are erroneous (1922, Jour. N. Y. Ent. Soc., XXX, 100). However, Proctor has recorded the species from Mount Desert Island, Me. (1938, Biological Survey of the Mount Desert Region, Part VI, 166).

Brachysomus echinatus Bonsd. The occurrence of this species near Trois Rivieres, Que., has been noted by Beaulne (1940, Can. Ent., LXXII, 62). I have

seen three of the specimens which were taken on June 3, 4, and 8, 1938 by Mr. Paul-Eugene Mercier who informs me that they were taken by sweeping a sandy area situated on the St. Lawrence River about twelve miles west of Trois Rivières. *Brachysomus* Steph. may be placed near *Barypeithes* Duv. from which it differs in type of vestiture. *B. echinatus* is a very robust, reddish-brown species measuring from 2.2 to 2.8 mm. Each elytral interval is supplied with three or four irregular rows of elongate, whitish scales and a row of long, stout, erect setae. The head and pronotum are supplied with similar vestiture, the setae of these parts being shorter and the white scales forming a narrow median and wide lateral vittae on the pronotum. The tarsal claws are connate at base. In *echinatus* the body is more robust and the pronotum is much shorter than in *Barypeithes pellucidus* Boh.; except for these differences and the differences in the vestiture, the two species resemble one another rather closely.

Philopodon plagiatum Schall. This species has not been reported previously from America. Mr. L. L. Buchanan informs me that the collections of the United States National Museum contain a specimen taken in 1934 on Amherst Island of the Magdalen group. In 1939 I found the species very abundant on sand beaches near Tracadie and Tabusintac, N. B. The beetles were most common on sand supporting no vegetation except a sparse growth of *Elymus arenarius* L. upon which they occasionally fed. During the beetles' season of activity, I visited similar beaches near Bathurst and Shediac but was unable to find the species, which suggests that it is not widely distributed in north-eastern New Brunswick. The species is said to confine itself largely to coastal regions in Europe. *Philopodon* Steph. is allied to *Trigonoscuta* Mots. and falls with the latter in Pierce's key (1913, Proc. U. S. N. M., XLV, 405). The rostrum is separated from the front by a transverse groove, and the tibiae, tarsi, and scrobes are rather similar to those of *Trigonoscuta*. *Philopodon* differs in having the tarsal claws connate at base, in having the antennal scape extending only to the middle of the eye, and in having the head and rostrum less elongate. In *plagiatum* the body is concealed by cinereous and pale brown scales. The color is quite variable, but except rarely, the elytral scales are brownish above, at least on the alternate intervals, and pale near the lateral margins. The body is even more robust than in *Trigonoscuta pilosa* Mots. and bears erect hairs which are much less conspicuous than those of *pilosa*. *P. plagiatum* measures from 4 to 7 mm.

Brachyrhinus rugifrons Gyll. The true *rugifrons* is known to occur in North America only at Sydney, N. S., where it was taken by Harrington in 1884, 1890, and 1894. Harrington recorded his earlier captures (1891, Can. Ent., XXIII, 22, 114), and Buchanan has noted the confusion in the literature of this species with *rugosostriatus* Goetz (1927, Can. Ent., LIX, 183).

Brachyrhinus singularis L. This species seems to be very scarce or local in North America, and there are few published records of its occurrence. Under the name *picipes* Fab., it was reported at Essex, Mass., in 1872 (2nd Ann. Rept. Ins. Mass.), and it has been recorded from Stoneham, Mass., and Montreal, Que. Rev. Brother J. Ouellet informs me that it was first taken at Montreal by himself in 1902 and that he took specimens at Lauzon, Que., in 1919. The Canadian National Collection contains specimens taken at Guelph, Ont., in 1904, at Victoria, B. C., in 1937, and others from Yarmouth and Halifax Co., N. S., and Charlotte Co., N. B.

Brachyrhinus ligneus Oliv. In 1928 Blatchley reported the occurrence of the true *ligneus* at Machias, Me. (Jour. N. Y. Ent. Soc., XXXVI, 240). The species is evidently very abundant in parts of the Maritime Provinces. The Canadian National Collection contains long series collected at St. Stephen, N. B., in 1917 and at Economy, N. S., in 1927 as well as specimens taken at Yarmouth, N. S., in 1933 and 1935.

Brachyrhinus porcatus Hbst. A single specimen of this species was taken at Montreal, Que., on April 25, 1937, by the Rev. Brother J. Ouellet who believes it was found in Jarry Park which is situated within the city. The species differs from all others occurring in North America in having the alternate intervals of the elytra elevated and broken into coarse granules.

Trachyploeus bifoveolatus Beck. Buchanan has recorded the occurrence of this species at Barneveld (1917) and Oriskany (1931), N. Y., Riverport, N. S. (1936), and Chipman, N. B. (1936) (1937, Jour. Wash. Ac. Sci., XVII, 312). The Canadian National Collection contains specimens from those Canadian localities and from Tabusintac (1939), Fredericton (1932), Boiestown (1928), and Bouctouche (1928), N. B. The species is frequently very abundant.

Sitona cylindricollis Fahr. In 1934 Hyslop wrote that this species was first found in the United States at Middlebury, Vt., in 1933 and that it was collected also at Storrs, Conn., Amherst, Mass., and on the New York side of the Lake Champlain Valley (Jour. Ec. Ent., XXVII, 562). In 1927 I found the species abundant from Montreal, Que., to a point on the International Boundary near Hemmingford, Que., and the Canadian National Collection contains specimens taken at Hemmingford in 1924 and 1925. I took *cylindricollis* at Shediac, N. B., in 1939 and have seen specimens from Nova Scotia. The species was very abundant in the Ottawa district in 1928. Caesar (1936, 66th Ann. Rept. Ent. Soc. Ont., 1935, 54) and Goble (1937, 67th Ann. Rept. Ent. Soc. Ont., 1936, 35) found it very abundant throughout southern Ontario as far west as Georgian Bay in 1935 and 1936. It was unknown in Manitoba until 1939 when it was found to be very abundant and widely distributed in the southern part of the province.

Hypera punctata Fab. According to Essig, a specimen of this species was taken in Pennsylvania before 1856 by Melsheimer, and another was collected in Canada by D'Urban in 1853 (1931, A History of Entomology, 193). As D'Urban's collecting was done in southern Quebec, it is probable that his specimen came from that region. The American distribution and history of this and other species of the genus has been given by Titus (1911, Ann. Ent. Soc. Am., IV, 383-473). The species now occurs from Nova Scotia to Georgian Bay, throughout northeastern and in central United States, and on the Pacific coast from central California to British Columbia.

Hypera meles Fab. According to Titus (op. cit.), this species was first collected in North America at Rockaway Beach, N. Y., in 1907. Titus recorded it from localities in New England, New York, and New Jersey. Subsequently, it was reported from New Brunswick and southern Quebec. It is represented in the Canadian National Collection by specimens taken during recent years at Tabusintac, Shediac, and Bathurst, N. B., and at Ottawa and Arnprior, Ont.

Hypera nigrirostris Fab. The earliest North American collections of this species that were known to Titus (op. cit.) are as follows: "Can." and Mt. Washington, N. H., in 1874; Cambridge, Mass., in 1873; and Detroit, Mich., about 1875. The species is now abundant and widely distributed in southern Canada as far west as Lake Kipawa, Que., and Georgian Bay. It is widely distributed in northeastern United States and has been reported from Montana, Oregon, Washington, and southern British Columbia.

Cleonus piger Scop. This species was first found in North America at Branchport, N. Y., by Crosby and Blauvelt in 1929 (1930, Ent. News, XLI, 164). The Canadian National Collection contains specimens taken in 1935 at Oswego, N. Y., and a single specimen collected in 1933 at Cascapedia, Que., which is situated near the southern shore of the Gaspé peninsula.

Amalus haemorrhous Hbst. This species was first recorded by Buchanan who reported a specimen from Syracuse, N. Y., in 1923 (Proc. Ent. Soc. Wash.,

XXV, 79). Blatchley reported specimens from South River and Lakehurst, N. J., in 1925 (Jour. N. Y. Ent. Soc., XXXIII, 105), and Frost recorded specimens taken at Hopkinton, Mass., in 1926 and at Sherborn, Mass., in 1932 (1932, Bull. Brook. Ent. Soc., XXVII, 184). The Canadian National Collection contains specimens taken at Renwick and Ames, Ia., in 1928. The species is common and widely distributed in eastern Canada. I found it abundant near Montreal in 1927 and have taken it since then at Brome and Lake Kipawa, Que., in the Ottawa and Lake Erie districts of Ontario, and in Riding Mountain Park, Man.

AN ADAPTION OF A STANDARD BI-METALLIC THERMO-REGULATOR TO CONTROL VARIABLE TEMPERATURES

BY GEO. WISHART,

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In entomological investigations it is frequently desirable to use varying temperatures rather than constant temperatures. The apparatus herein described, when installed in a rearing or storage chamber, makes it possible to control temperatures in any desired graph pattern over a period of twenty-four hours*, and to repeat the same pattern any desired number of times. This is accomplished by removing the usual adjusting mechanism from a DeKhotinsky-thermo-regulator** and substituting for it an automatic adjuster operated by a synchronous electric clock.

In the DeKhotinsky thermo-regulator the control knob, through a worm gear, turns a small wheel which is fast on a sleeve leading to the fixed end of the bi-metallic helix. This bi-metallic helix is the activating element of the thermo-regulator, and when the fixed end is turned by the operation of the control knob, the adjustment of the thermo-regulator is changed. In the present apparatus the knob and worm are removed and an adapter, as illustrated, is clamped around the small wheel. A lever from this adapter has its extremity riding on the periphery of a disc which is mounted on the arbor of a synchronous electric clock geared to give one revolution per day. The weight of the adapter keeps the lever riding on the disc. The lever moves in and out from the clock arbor following the shape of the disc, and the movement is carried back to the fixed point of the bi-metallic helix, changing automatically the adjustment of the thermo-regulator.

Calibration of the instrument is most easily obtained by operating it with plain circular discs of different sizes for short periods, checking with a thermometer or thermograph. In this way the distance of movement from the centre of the clock arbor per degree of temperature is determined. With this information, a circular twenty-four hour graph chart is made, marked off in degrees and hours. On this the desired temperature graph is drawn, the design transferred to the material from which the disc is to be made, and the disc cut out. The disc is then mounted on the clock arbor by use of the adapter as illustrated. Heavy Xylonite is used for the disc, but sheet metal would also be satisfactory. The hours are etched on the disc to facilitate setting. The shape of the disc determines only the temperature pattern. Coarse up and down adjustment is secured by use of the set screw *B*, and fine adjustment by the adjusting screw on the end of the lever.

*A very excellent device for reproducing temperatures over a week was described by W. E. Stone; "An Instrument for the Reproduction, Regulation and Control of Variable Temperatures", Jour. Wash. Acad. Sci., Oct., 1939.

**Permission by courtesy of the Central Scientific Company of Canada, Ltd., Toronto, Ont.

PLATE V.

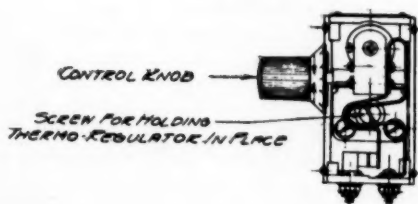


Fig. 1.

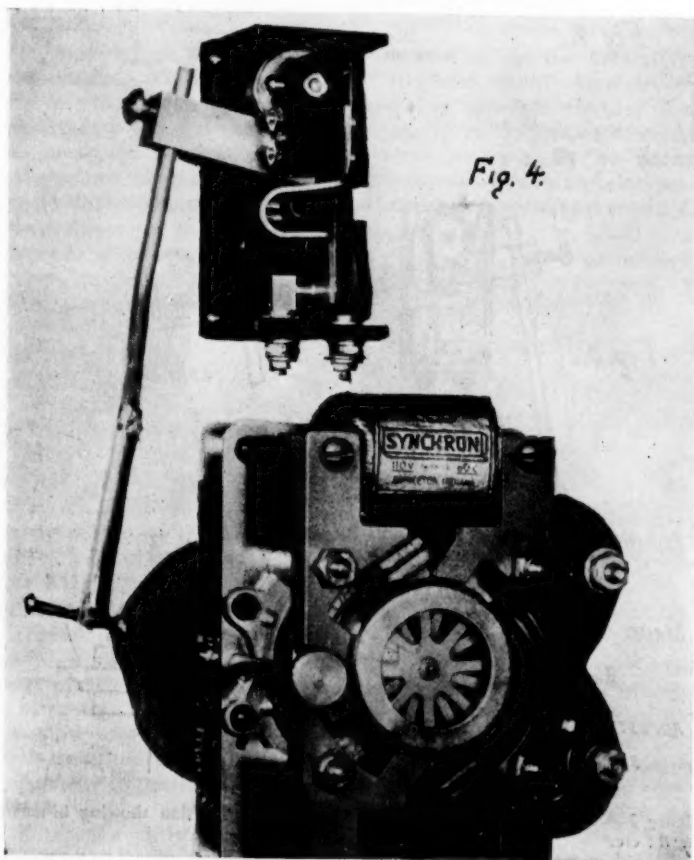


Figure 1—Thermo-regulator in normal condition with control knob and worm in place.

Figure 4—Photograph of actual apparatus, the clock is mounted forward of the thermo-regulator so as not to interfere with the mounting of the thermo-regulator in the incubator.

PLATE VI.

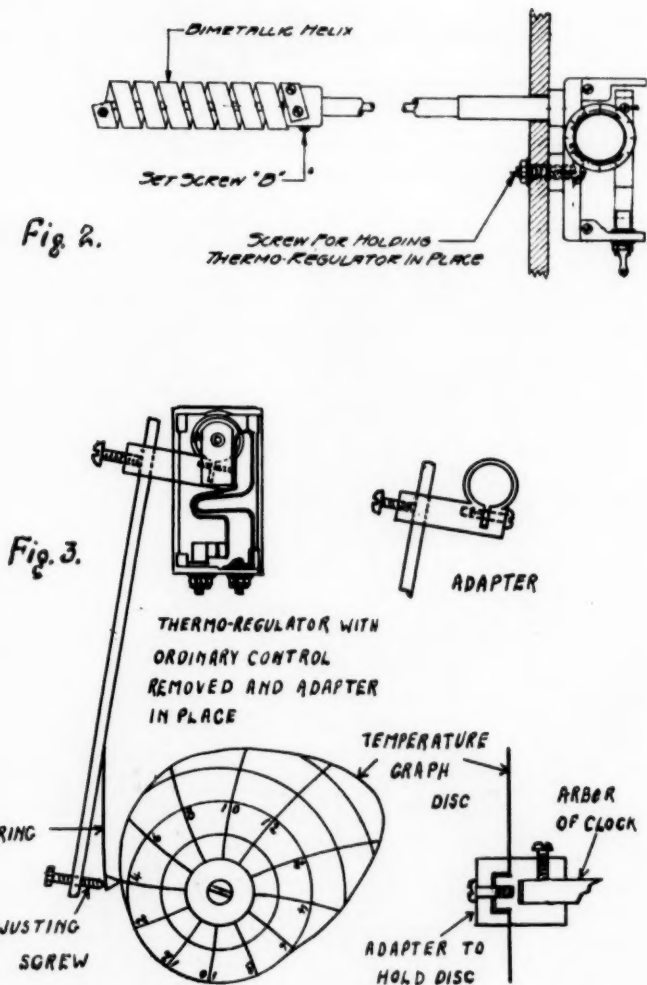


Figure 2—Side view of thermo-regulator in normal condition showing bi-metallic helix, set screw B, etc.

Figure 3—Thermo-regulator with control knob and worm removed and adapter in place; details of lever and disc, details of adapter; details of adapter for holding disc on clock arbor.

The unit illustrated is capable of operation over a range of approximately 85 degrees Fahrenheit. Rapidity of rise of temperature of any incubator using this type of regulation will be limited by the capacity of the heating unit. Rapidity of drop of temperature will be limited by such factors as amount of insulation used in the construction of the chamber and ventilation. Where rapid cooling is required, it may be necessary to add forced ventilation or artificial cooling. To control these mechanical aids to cooling, it would be necessary to use a thermo-regulator similar to the one described but having a single pole double throw arrangement, one pole being used to control the heating and the other to control the mechanical cooling.

By using a suitably shaped disc with a clock geared to one revolution per week, temperatures for a whole week could be reproduced in like manner.

SOME NEW DIURNAL LEPIDOPTERA FROM THE RIDING MOUNTAINS AND THE SAND RIDGE, MANITOBA

BY F. H. CHERMOCK AND R. L. CHERMOCK,
Wilmerding, Pennsylvania

For many years the authors have been studying the butterflies of the Riding Mountains and of the Sand Ridge* and have found numerous forms and races new to science. In a paper read some time ago at a meeting of the Pennsylvania Academy of Sciences, many of these forms and races were described. To make these descriptions available to more students, Dr. J. McDunnough suggested that we use the "Canadian Entomologist". All the holotypes will be deposited in the Canadian National Collection and the allotypes in the Carnegie Museum.

Euchloe ausonides mayi new race

Upper Surface. Primaries: Characteristic black markings of *ausonides* Bdv. reduced in intensity; frequently the black spot at the end of the cell so reduced that it appears disjunct. Secondaries: In the male, similar to *ausonides*; in the female, a tinge of yellow suggestive of *semiflava* Comst.

Lower surface. In both sexes the green spots, so typical of *ausonides*, are greatly reduced and in many individuals are overcast by bright yellow scales.

Holotype—♂, June 12, 1933, Riding Mountains, Manitoba.

Allotype—♀, July 31, 1933, same locality.

Paratypes—1 to 100, various dates, same locality.

We take great pleasure in naming this race in honor of our good friend Mr. J. F. May who has so kindly furnished us with thousands of butterflies from the localities herein considered.

Colias christina mayi new race

This subspecies in color and marking is very similar to *gigantea* (Stkr.) on the upper surface in both sexes; however, it may be readily separated from its nearest relative *gigantea* by the absence of the heavy overcast of black scales on the secondaries and the costal area of the primaries. There is in *mayi* a very sparse sprinkling of black scales on the area just mentioned. The pink fringes are less intense in *mayi* than in *gigantea*.

The marginal band of the female varies from a fairly well defined band on the primaries to the total absence of a band.

Holotype—♂, July 1, 1933, Riding Mountains, Manitoba.

Allotype—♀, July 1, 1936, same locality.

Paratypes—1 to 150, same locality.

This race is very abundant in the Riding Mountains.

*The Sand Ridge is a region of gravel ridges, covered with oak thickets and prairie vegetation, situated about ten miles northeast of McCreary, Manitoba. It is not far from the eastern border of Riding Mountain National Park, and it should not be confused with the town of Sandridge which is situated about fifty miles north of Winnipeg. Editor.

***Collas christina mayi* form *marjorie* new form**

This is the white female of the race and illustrates all of the variable tendencies of the race in reference to the black markings on the primaries.

Holotype—♀, June 26, 1933, Riding Mountains, Manitoba.

Paratypes—1 to 50, same locality.

***Oeneis jutta ridingiana* new race**

This subspecies has, on the upper side, the same ground color as typical *jutta* from eastern United States and Canada. The submarginal row of spots, instead of being yellow as in typical *jutta*, is of an ochraceous color as in *reducta*. It differs from *reducta*, however, in the fact that the spots are not so greatly pronounced that they form a band, but remain a disjunct row of spots. On the underside, the maculation is the same as in typical *jutta* but is a little darker. Also, the yellow is again replaced by the ochraceous color. *Reducta* does not show this banding although it has the ochraceous coloring characteristic of the new subspecies.

Holotype—♂, July 12, 1933, Riding Mountains, Manitoba.

Allotype—♀, June 18, 1937, same locality.

Paratypes—1 to 40, all from the same locality, various dates.

***Argynnis cybele pseudocarpenleri* new race**

The authors have a large series of this butterfly and have noticed that they are quite distinct, especially in the females, from typical *cybele*. It was the consistency of the paleness in the females that first attracted our attention and led to an intensive study of *cybele* and its varieties. We have examined type material of all the named variants in addition to our own extensive series of specimens. We have found that its nearest relative is *carpenleri* Edw., the types of which are in the Carnegie Museum.

Male. 2.12 inches, average. Upper surface: In color, about the same as in normal *cybele*, the black markings generally reduced. Lower surface: The brown margin on the secondaries consistently complete.

Female. 2.25 inches, average. Upper surface: Possesses the reduced black spots as in the male, but the most striking characteristic is a light yellowish-tan ground color in contrast to the darker typical form; it also possesses white marginal spots on the primaries. Lower surface: The marginal bands on the primaries and secondaries, and the discal and basal areas of the secondaries, a deep chocolate brown.

Holotype—♂, July 19, 1934, Sand Ridge, Manitoba.

Allotype—♀, July 7, 1937, Riding Mountains, Manitoba.

Paratypes—1 to 250, Riding Mountains, Manitoba; Sand Ridge, Manitoba; Miniota, Manitoba; Banff, Alberta, and McCreary, Manitoba.

Some may confuse this race with *Argynnis cybele krautwormi* (Holland); *krautwormi*, however, is a pallid form of the normal *cybele* and is not a distinct race. The authors have taken *krautwormi* in the Pittsburgh area and the specimens agree with the types.

***Argynnis atlantis hollandi* new race**

In both sexes, the upper surface is almost identical with the type form, except that the black marginal band is consistently black, while in the typical form, it is interspersed with brown. On the lower surface, however, the discal and basal areas of the secondaries and the marginal bands of both wings are a deep black-brown in contrast to the lighter brown color of typical *atlantis*. This character is constant in specimens from this locality. We have examined the types of *atlantis* (Edwards), *nikias* (Ehrmann), paratypes of *canadensis* (dos Passos), and the types of *beani* (B. & Benj.) and find that this race is unique in the darkness of its underside. We take great pleasure in naming this after our late friend, Dr. W. J. Holland, whose work in the field of Lepidoptera is too well known to require further explanation.

Holotype—♂, July 24, 1934, Riding Mountains, Manitoba.

Allotype—♀, July 16, 1937, same locality.

Paratypes—1 to 550, Riding Mountains, and Sand Ridge, Manitoba.

***Argynnis manitoba* new species**

The nearest relative of this new species is *Argynnis lais*, although it has its distinctive characters which readily distinguish it from the other argynnids.

Male. 2 inches, average. Upper surface: Generally similar to that of *lais* except for a more rufous ground color and heavier black markings. Lower surface: On the primaries, the black markings are very intense and wide, whereas in *lais* they are very narrow; the ground color is reddish except at the apex; in *lais*, however, this ground color is more yellowish. On the secondaries, the discal and basal area varies from brown to a dark rufous-brown. The sub-marginal band of silver spots are more or less elongated in this species. The dark marginal lunules, in which the silver occurs, extend from vein to vein forming a triangular shaped lunule, whereas in typical *lais* these spots do not quite extend from vein to vein.

Female. 2.25 inches, average. Upper surface: Very similar to that of *lais* except that the black markings are more pronounced, so that the marginal lunules on the primaries form a continuous chain. As in the male, the color is more rufous than in *lais*. Lower surface: Displays the same characteristics as male, often to an even greater extent.

Holotype—♂, July 29, 1934, Sand Ridge, Manitoba.

Allotype—♀, August 5, 1934, Sand Ridge, Manitoba.

Paratypes—1 to 150, all from the same locality.

Included in the authors' collection are hundreds of argynnids from Manitoba and the surrounding provinces and states; never has this species been encountered elsewhere. It appears to be abundant on the Sand Ridge in Manitoba.

***Phyciodes nycteis reversa* new race**

In *nycteis*, there exists a parallelism to *Melitaea harrisi* and its forms; *Melitaea harrisi*, *Phyciodes nycteis*; *Melitaea harrisi liggettii* (Avinoff), *Phyciodes nycteis drusius* (Edwards); and *Melitaea harrisi albomontana*, *Phyciodes nycteis reversa*. This new race, although displaying the same general characters as typical *nycteis*, may be easily separated by the abbreviation and omission of black markings as in *Melitaea harrisi albomontana*. The under surface has the characteristic markings of *nycteis*, but less distinct.

Holotype—♂, June 27, Riding Mountains, Manitoba.

Allotype—♀, June 27, Riding Mountains, Manitoba.

Paratypes—1 to 50, Sand Ridge, Manitoba, and Riding Mountains, Manitoba.

The holotype and allotype were taken *in copulo*.

***Poanes hobomok ridingsii* new form**

This form has the same relationship to *hobomok* that *suffusa* has to *masasoit*. The upper surface is slightly darker in color than that of *hobomok*. The yellow discal patch on the secondaries below is very heavily overcast by brownish scales. We have a very extensive series of this form from the Riding Mountains where it appears to be constant. From Montreal, we have a fair series collected by our generous friend Mr. Sheppard. At Montreal this form occurs with the typical form. The classification "form" is based on this latter material; however, in the Riding Mountains, *ridingsii* occurs as a race. With sufficient material from the regions between the two localities, interesting theories could be formulated.

Holotype—♂, June 23, 1938, Riding Mountains, Manitoba.

Allotype—♀, June 7, 1934, Riding Mountains, Manitoba.

Paratypes—Riding Mountains, Sand Ridge, Man., and Montreal, P. Q.

AN APPARENTLY NEW ALASKAN PLATYPTILIA (LEPIDOPTERA, PTEROPHORIDAE)

BY W. H. LANGE, JR.,
University of California, Berkeley, Calif.

Barnes and Lindsey in their monograph of the American Pterophoridae* mentioned the fact that they had examined a series of a *Platyptilia* in the Fernald collection from St. George and St. Paul Islands, Alaska, which was scarcely recognizable as *P. pallidactyla* Haw., but was placed under this species because of the poor nature of the series.

During July, 1939, E. C. Johnston collected a series of a *Platyptilia* species on St. Paul Island, Alaska, which seems referable to the species examined by Barnes and Lindsey. The species is named for the collector, E. C. Johnston, who kindly presented me with the series for study and whose careful and diligent collecting has brought to light this very interesting *Platyptilia*.

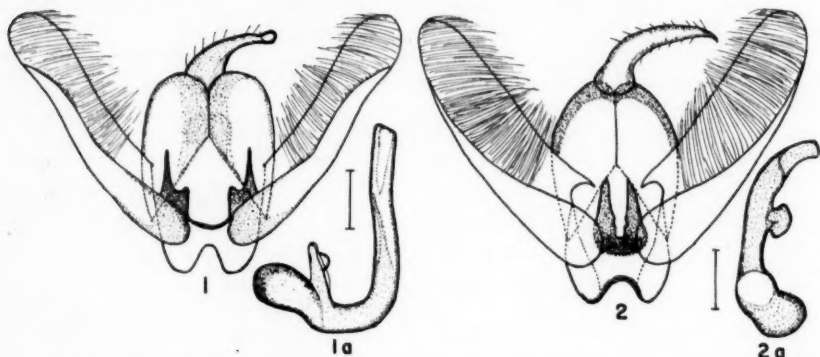


Fig. 1. *Platyptilia johnstoni* n. sp., male genitalia; 1 a, aedeagus. (Line equals 0.264 mm.)

Fig. 2. *Platyptilia pallidactyla* Haw., male genitalia; 2 a, aedeagus. (Line equals 0.264 mm.).

Platyptilia johnstoni n. sp.

Related to *pallidactyla* Haw. The male with the forewings uniform gray and brown; the female, with an oblique dash on the first lobe similar to *petrodactyla* Wlk. Expanse 19-24 mm.

Male. Expanse 22 mm. Palpi slightly surpassing frontal tuft; first joint with white and light brown scales; second, outwardly a uniform light brown; third joint lighter with a few white scales. Head light brown; frontal tuft present, broadly conical. Antennae uniform brown. Thorax light brown with patagiae slightly lighter. Forewings with background grayish; darker along costa until opposite cleft where it is interrupted with white, then continues dark to apex; a darker brown line extending along radius from base of wing, but not quite reaching cleft; along inner margin a darker suffusion, interrupted at center, extending to anal angle; first lobe generally overcast with brown scales, but grayish toward outer margin; cilia of cleft white; below cleft a small patch of dark brown scales; second lobe a mixture of brown and gray scales; cilia white, slightly darker apically, at tornus a dark brown cleft; inner margin with dark dash in cilia, with few scattered dark scales beyond. Hindwings uniform dark brown with brown cilia, slightly darker apically; third lobe with a weakly developed scale tuft of dark scales at the

*The Pterophoridae of America, north of Mexico. Contributions to the Natural History of the Lepidoptera of North America. vol. 4 (4), 344, 1921.

center. Abdomen uniform light brown. Legs uniform light to dark brown; annuli not distinct.

Male genitalia with valves (harpes) broad, but narrower than in *pallidactyla* and slightly constricted two-thirds from base; anellus lobes with two points, similar to *washburnensis* McD.; uncus slightly knobbed apically; aedeagus long, curved.

Female. Same size as male. Forewings with an oblique black dash paralleling white transverse line at center of first lobe; color in general fawn, lighter than male; gray suffusion mostly lacking; other features as in male.

Female genitalia with ovipositor short and stout in comparison to *pallidactyla* Haw.; posterior apophyses well developed, but anterior apophyses short, poorly developed; ostium bursae opening between two lobes, differing from *pallidactyla* where the opening is on the left side; ductus bursae chitinated most of its length; armature of bursa copulatrix two short spines, approximately 0.22 mm. long, differing from *pallidactyla* where the spines are 0.57 mm. long.

Holotype—♂, St. Paul Island, Alaska, July 14, 1939; collector, E. C. Johnston.

Allotype—♀, data as in holotype; collected on July 19, 1939.

Paratypes—5 ♂, same data; 2, July 14, 1939; 1, July 19; 2, July 28. 12 ♀, same data; 1, July 14, 11, July 19.

The male genitalia of *P. washburnensis* McD.* are similar in the structure of the anellus lobes and in the form of the harpes to *johnstoni* n. sp., but the former is a smoky brown species from Mt. Washburn, Yellowstone National Park, Wyoming. Most of the specimens show two black spots at the base of the cleft of the forewings as found in *albertae* B. & L.

Johnstoni can be separated from *pallidactyla* Haw. by the male and female genitalia (Figs. 1 and 2, ♂), the blunter apices of the forewings, the shorter and more robust palpi, and the gray suffusion of the male.

Mr. Johnston informs me that *johnstoni* was captured in a region of large boulders, especially at the bases of volcanic cones, flying among black crowberry (*Empetrum nigrum* L.), grasses, ferns, and sphagnum moss.

*McDunnough, J. Some apparently new microlepidoptera. Can. Ent. vol. 61, p. 269, fig. 3, 1929.

A NEW SPECIES OF BRACHYCYRTUS FROM BRITISH COLUMBIA (HYMEN.; ICHNEUMONIDAE)*

BY G. STUART WALLEY,
Ottawa, Ont.

It was with some surprise that the writer encountered a representative of this rare and, until recently, little known genus, from a locality in south-eastern British Columbia. The specimen in question is a female reared at Ottawa, by officers of the Forest Insect Survey of the Division of Entomology, from the cocoon of a Chrysopid beaten from Engelmann spruce, Aug. 26, 1938, by Mr. D. H. Ross of the British Columbia Forest Service, in the vicinity of Bayne's Lake, B. C. The adult parasite emerged in the laboratory, Feb. 20, 1939.

In Cushman's recent synopsis of *Brachycyrtus* (Proc. U. S. N. M., Vol. 84, pp. 17-24, 1936) the above specimen falls closest to the Japanese species, *B. nawaii* (Ashm.), but will not trace to that species in his key because of the narrower malar space and the absence of a strong carina anterior to the scutellar fovea. In respect to the form of the epomia, the junction of the occipital and hypostomal carinae, and the position of the nervulus, the specimen agrees with *nawai*. It further agrees with *nawai* in the deeply emarginate eyes, as illustrated by Cushman, and in having the propodeal carinae arranged exactly as in his

*Contribution from the Division of Entomology (Systematic Entomology), Department of Agriculture, Ottawa.

figure. From the descriptions of the structure of *nawai* given by Cushman in the above cited paper, and in his earlier notes (Proc. U. S. N. M., Vol. 55, p. 543, 1919) and the original description (largely color) by Ashmead, the specimen here dealt with differs only as follows.

***Brachyeyrtus chrysopae* n. sp.**

Female.—Length approximately 6 mm., sheath 1.75 mm.; malar space one-half as long as basal width of mandible; occipital carina evenly, moderately curved inwardly, joining hypostomal carina at a point nearly as far behind base of mandible as basal width of mandible; scutellar groove foveolate but not margined anteriorly by a sharp carina; propodeal spiracle small, elongate; abscissa fully one-half as long as intercubitalia; gastrocoeli narrow, elongate, situated remote from lateral margin of second tergite and about their own length from the base.

Black, with pale yellow markings in general similar to *nawai* but more reduced; differs in having the face black except an orbital spot on either side below antennae, the spots narrowly joined above immediately below the antennae; only upper half of hind orbits very narrowly yellow and not joined by a yellow band across the vertex; frontal orbits more broadly yellow; mesonotal stripes narrow, almost interrupted near middle; small subalar yellow spot; mesopleura without a yellow spot anteriorly; propodeum mostly brownish-black, yellowish portions confined to a large spot before spiracle, and the lateral areas behind costulae extending onto pleural areas above hind coxae; hind coxae black except at apex anteriorly; hind femora broadly yellowish at base and narrowly so at apex, the intervening portion dark brownish; hind tibia pale brownish (darker below) except at base; first abdominal segment reddish-brown with blackish suffusions above at base and on post-petiole, the apex of latter pale yellow; tergites two to five black, each with a transverse preapical pale yellow band which is narrowly on the fourth and more broadly on the fifth interrupted by a median extension of the blackish portion; apices of tergites two to five narrowly reddish-brown; the second and third tergites also with a reddish-brown trapezoidal spot on either side anterior to the yellow band, these two areas separated by a broad, median, wedge-shaped extension of the black basal portion; tergites six and seven black with a fine, apical, yellow line; eighth tergite reddish-brown; sheath black; inflexed portions of tergites two to six pale brown; sternum yellowish.

Holotype.—♀, near Bayne's Lake, B. C. (emerged in laboratory, Feb. 20, 1939) D. H. Ross. No. 5049 in Canadian National Collection, Ottawa, Ont.

Host.—Unknown species of Chrysopidae.

RESEARCH NOTES

PREOCCUPIED NAMES IN THE GENUS *HOMONEURA* (DIPTERA, LAUXANIIDAE)

It has been brought to my attention that the name *Homoneura praeapicalis* used by myself recently (1939, Can. Ent., LXXI, 264) is preoccupied by *H. praeapicalis* Malloch, applied to a species of New South Wales (1925, Proc. Linn. Soc. N. S. W., L. 320). On referring to Malloch's paper, I was embarrassed to find that my name *H. armata* (l. c.) is also a homonym, it having been used by Malloch in the paper cited above for another Australian species. I therefore propose the new names *setitibia* to replace *praeapicalis* Shew. and *cactifera* to replace *armata* Shew.

G. E. Shewell, Division of Entomology, Ottawa, Ont.

A NOTE ON THE HABITS OF MATURE CODLING MOTH LARVAE

Observations made in an apple orchard throughout the day and night have shown that, in the majority of cases, codling moth larvae, seeking places to spin up, leave the fruit only during the hours of darkness. This habit must greatly diminish the possible effectiveness of diurnal parasites and predators.

It was noted also that a high proportion of first and a low proportion of second brood mature larvae left the fruit before it fell to the ground.

W. G. Garlick and H. R. Boyce,

Dominion Entomological Laboratory, Vineland Station, Ontario.

THE MIGRATION OF CODLING MOTH LARVAE FROM ONE APPLE TO ANOTHER

The writer has suspected for some time that codling moth larvae will sometimes leave one apple to enter another. Lately it has been clearly proved that this happens much more frequently than was at first supposed and involves larvae in all stages of growth. Beyond the well known case of apples which are touching one another the writer is not aware that this migration has been reported by other observers. Its importance lies mainly in the fact that partly grown larvae are not likely to be poisoned on entering a fresh fruit no matter how much spray may be on the latter, thus two or more fruits may be ruined by a single larva. Moreover, since the migration almost always takes place under cover of darkness, there is less danger to the exposed larva from predators.

The first detailed observation was made in 1935 when, on a dull misty day, a nearly full grown larva was noted on a branch and its movements followed. It entered a hitherto uninfested apple and fed there for six days before coming out to pupate. In that time it penetrated the apple to the core and did extensive feeding. During the last two years the writer has been examining fruit on trees at regular intervals and marking new entries as observed. In this time no larvae have been seen migrating but the evidences of its having taken place were unmistakable. Migration began quite early in the season and was usually first noted where infested apples failed to develop (as in the case of 'June drops'). Larvae left such fruits before they fell and moved to fresh fruits, often several feet away. Cases have been noted where the larvae came out only to re-enter the same fruit, perhaps because the first tunnel became filled with sap.

It would be interesting to know to what extent this migration has been observed by other workers or whether it is a new annoying habit which the codling moth is developing.

W. G. Garlick,

Dominion Entomological Laboratory, Vineland Station, Ontario.

ADDITIONAL FULGORIDAE TAKEN IN ALBERTA

Prior to 1937, when a list (Can. Ent., LXIX, 94-95) of twelve species of Fulgoridae which had been taken in Alberta was published, two species only had been recorded from this province.

Somewhat extensive sweeping of low growing vegetation in recent years has produced nine additional named species. This brings the total for the province to twenty-one named species. In addition to these Dr. Metcalf, to whom part of the collection has been submitted, finds that at least one new species is represented.

The following are the new records, all of which have been determined by Dr. Metcalf unless otherwise stated.

Scolops grossus Uhl. Medicine Hat, VIII. Common on sweet clover by roadsides.

Olarius fransiscanus Stal. Edmonton, VI-VII. Nymphs and adults fairly common on *Artemisia* (sage) growing on cutbanks by rivers. None could be found on sage growing on the level prairie.

Apache degeeri Kby. Edmonton, VIII. A single specimen of this remarkable species was taken by Mr. W. R. Mason on a road.

Stenocranus arundineus Met. Tilley, Medicine Hat, VI-VIII. A single male of what I take to be this species was included in a collection of Chermidae which had been swept by Dr. R. W. Salt from alfalfa, and a female which probably belongs here was taken from *Grindelia* (Gumweed).

Pissonotus basalis V. D. Lethbridge, VIII. Nymphs and adults common on *Grindelia squarosa*.

Pissonotus aphidoides V. D. Donnelly, VII. Two adults on *Castilleja coccinea* (Indian paintbrush).

Phyllodinus nervatus V. D. Edmonton, Wabamun, VI-VII. Several specimens swept from grass growing under willows.

Delphacodes kilmani V. D. Edmonton, Wabamun, Dapp, High Prairie, VI-VII. This species is common on *Equisetum* spp. (Horsetail) which is growing in the shade of trees.

Achorotile albosignata Dahl. Beaverlodge. This species, which was taken without further data, was recorded in 1937 as *Criomorphus* (?). Dr. E. D. Ball has subsequently given us the correct determination.

The only other changes which should be made in the former list are that Dr. Metcalf places *pellucida* and *campestris* in the genus *Delphacodes* in preference to *Liburnia* and that he has confirmed the determinations which I then credited to myself.

By far the commonest Fulgorid in Alberta appears to be *Delphacodes pellucida* Fab. The species can be swept, almost universally, from the extreme south to the Peace River District, from vegetation growing in low, damp places. Nymphs are frequently abundant in the spring on *Potentilla*, slough grass, and reeds.

E. H. Strickland.

Mailed Tuesday, April 30th, 1940.

Guelph Printing Service

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